CLAIMS

What is claimed is:

[c1] A system for detecting radiation phenomena in an area surrounding a wellbore traversing an earth formation, comprising:

an elongated support member adapted for disposal within said wellbore;

radiation detectors mounted on said support member, at least one of the detectors adapted to detect gamma ray related phenomena; and

at least one of said radiation detectors being segmented to provide focused sensitivity or adapted to provide multiple radiation phenomena measurements.

[c2] The system of claim 1, wherein the at least one detector adapted to provide multiple measurements comprises a radiation detector disposed within another radiation detector.

[c3] The system of claim 1, further comprising a radiation source mounted on said support member.

[c4] The system of claim 1, wherein at least one of the radiation detectors is adapted to detect neutron related phenomena.

[c5] The system of claim 1, wherein said support member is adapted for disposal within said wellbore during or after drilling of said wellbore.

[c6] The system of claim 3, wherein the radiation source comprises a controllable neutron source adapted to emit selected duration bursts of high-energy neutrons.

[c7] The system of claim 3, wherein the radiation source comprises an x-ray source.

[c8] The system of claim 1, further comprising a marker material adapted for disposal within the wellbore or the formation, said material being naturally radioactive or capable of being made radioactive when bombarded with neutrons.

[c9] The system of claim 1, wherein the at least one segmented detector is adapted to provide azimuthal sensitivity about said support member.

[c10] The system of claim 9, wherein the at least one segmented detector comprises a plurality of scintillation material segments joined together.

[c11] The system of claim 9, wherein the at least one segmented detector comprises two scintillation material segments joined together having a barrier material disposed between said segments.

[c12] The system of claim 9, wherein the at least one segmented detector comprises a plurality of scintillation material segments coupled to a multiplier adapted to convert light to electron signals.

[c13] The system of claim 1, wherein said support member comprises a plurality of radiation detectors adapted such that their individual sensitivities are focused about differing orientations relative to said support member.

[c14] The system of claim 13, wherein said plurality of focused radiation detectors are disposed on said support member such that they provide continuous azimuthal radiation detection about said support member.

[c15] The system of claim 14, wherein each detector of said plurality of focused radiation detectors comprises a shielded scintillation crystal, each said shield adapted to block the passage of radiation therethrough.

[c16] The system of claim 15, wherein each detector of said plurality of detectors is positioned axially proximate another one of said detectors along said support member.

[c17] The system of claim 15, wherein each said scintillation crystal is cylindrically formed.

[c18] The system of claim 17, wherein each said shield defines an arc of 90 degrees.

[c19] The system of claim 2, wherein the at least one multiple measurement detector is adapted to detect thermal or epithermal neutrons.

[c20] The system of claim 2, wherein the at least one multiple measurement detector is adapted to detect gamma rays.

[c21] A method for detecting radiation phenomena in an area surrounding a wellbore traversing an earth formation, comprising:

disposing a support member within said wellbore, said support member having radiation detectors mounted thereon, at least one of the detectors adapted to detect gamma ray related phenomena; at least one of said radiation detectors being segmented to provide focused sensitivity or adapted to provide multiple radiation phenomena measurements; and

detecting radiation phenomena with one of said radiation detectors.

[c22] The method of claim 21, wherein the at least one detector adapted to provide multiple measurements comprises a radiation detector disposed within another radiation detector.

[c23] The method of claim 21, wherein at least one of the detectors is adapted to detect neutron related phenomena.

[c24] The method of claim 21, wherein said radiation detecting step comprises detecting gamma ray related phenomena.

[c25] The method of claim 21, wherein said support member comprises a radiation source disposed thereon.

[c26] The method of claim 25, wherein said radiation source comprises a neutron source.

[c27] The method of claim 26, further comprising irradiating the formation or wellbore with neutrons from said neutron source.

[c28] The method of claim 21, wherein said support member is disposed within said wellbore during drilling of said wellbore.

[c29] The method of claim 21, wherein said support member is disposed within said wellbore after drilling of said wellbore.

[c30] The method of claim 26, wherein said neutron source is adapted to emit selected duration bursts of high-energy neutrons.

[c31] The method of claim 21, further comprising disposing a marker material within the wellbore or formation, said material being naturally radioactive or capable of being made radioactive when bombarded with neutrons.

[c32] The method of claim 21, wherein the at least one segmented detector is adapted to provide azimuthal sensitivity about said support member.

[c33] The method of claim 32, wherein the at least one segmented detector comprises a plurality of scintillation material segments joined together.

[c34] The method of claim 32, wherein the at least one segmented detector comprises two scintillation material segments joined together having a barrier material disposed between said segments.

[c35] The method of claim 32, wherein the at least one segmented detector comprises a plurality of scintillation material segments coupled to a multiplier adapted to convert light to electron signals.

[c36] The method of claim 21, wherein said support member comprises a plurality of radiation detectors adapted such that their individual sensitivities are focused about differing orientations relative to said support member.

[c37] The method of claim 36, wherein said plurality of focused radiation detectors are disposed on said support member such that they provide continuous azimuthal radiation detection about said support member.

[c38] The method of claim 37, wherein each detector of said plurality of focused radiation detectors comprises a shielded scintillation crystal, each said shield adapted to block the passage of radiation therethrough.

[c39] The method of claim 38, wherein each detector of said plurality of detectors is positioned axially proximate another one of said detectors along said support member.

[c40] The method of claim 38, wherein each said scintillation crystal is cylindrically formed.

[c41] The method of claim 40, wherein each said shield defines an arc of 90 degrees.

[c42] The method of claim 21, wherein the at least one multiple measurement detector is adapted to detect thermal or epithermal neutrons.

[c43] The method of claim 21, wherein the at least one multiple measurement detector is adapted to detect gamma rays.